PATENT COOPERATION TREATY

10/089139

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
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International filing date (day/month/year) 09 November 2001 (09.11.01)	**Priority date** (day/month/year) 10 November 2000 (10.11.00)
Applicant BOSWORTH, Adam et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

31 May 2002 (31.05.02)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

10/089139

Applicant's or agent's file reference 41016.P009PCT	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US01/46928	International filing date *(day/month/year)* 09 NOVEMBER 2001	Priority date *(day/month/year)* 10 NOVEMBER 2000
International Patent Classification (IPC) or national classification and IPC IPC(7): G06F 9/45 and US Cl.: 717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524		
Applicant BEA SYSTEMS, INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of — sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
31 MAY 2002	03 FEBRUARY 2003
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer for TUAN Q. DAM James R. Matthews Telephone No. (703) 305-3900

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/46928

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	1-38	YES
	Claims	NONE	NO
Inventive Step (IS)	Claims	1-38	YES
	Claims	NONE	NO
Industrial Applicability (IA)	Claims	1-38	YES
	Claims	NONE	NO

2. citations and explanations (Rule 70.7)

Claims 1-38 meet the criteria set out in PCT Article 33(2)-(4), because the prior art CARNEY et al do not teach or fairly suggest a method of computing that, at least, comprising the steps of "*recognizing a first code section ... invoking a first code statement processing unit ... recognizing a second code section... invoking a second...processing unit ...*", and in as such a manner as recited in independent claim 1 and/or its correspondent apparatus of independent claim 20.

Nor another method version that, at least, comprising the steps of "*recognizing a directive statement within the header section, enumerating one or more data packages; and importing the enumerated... data packages for use ... with at least statements of the selected first and second programming language*", and in as such a manner as recited in independent claim 14 and/or its correspondent apparatus of independent claim 33.

Nor another method version that, at least, comprising the steps of "*recognizing a first declare statement within the header section, enumerating one or more processing methods; and instantiatting the enumerated... processing methods for use ... with at least statements of the selected first and second programming language*", and in as such a manner as recited in independent claim 17 and/or its correspondent apparatus of independent claim 36.

Nor another method version that, at least, comprising the steps of "*recognizing a declare statement within the header section, enumerating one or more instance variables; and instantiatting the enumerated... instance variables for use ... with at least statements of the selected first and second programming language*", and in as such a manner as recited in independent claim 19 and/or its correspondent apparatus of independent claim 38.

Therefore, claims 1-38 meet the criteria set out in PCT Article 33(2)-(4).

NEW CITATIONS

NONE

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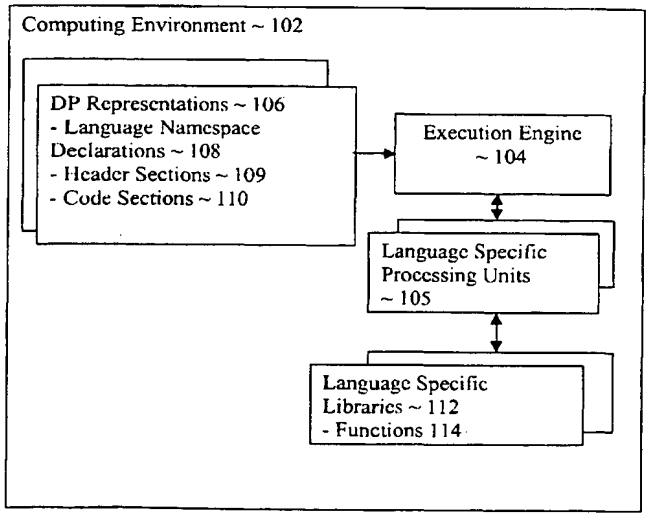
[Continued on next page]

(54) Title: A MULTI-LANGUAGE EXECUTION METHOD



(57) Abstract: A data processing representation is expressed in the form of code sections, which may be nested, using multiple programming languages. The representation is read by and execution engine. The execution engine indentifies the language of each code section, and a corresponding language specific processing unit is invoked to process the code section. The processing unit reads that section, identifying sub-sections specified in it's associated language and other sub-sections specified in unknown languages. It executes the sub-sections specified in its associated language with the intended in an unknown language is encountered, it delegates processing of that sub-section back to the execution engine, which repeats this process for the unknown sub-section. The execution result is returned back to the requesting language specific processing unit, which continues processing from where it left off.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A Multi-Language Execution Method

Related Applications

This non-provisional application is related to and claims priority to provisional application number 60/246,915, entitled "A Data Processing Method Employing Cell Based Data Flow Description", and application number 60/246,916, entitled "A Multi-Language Execution Method", both filed on November 10, 2000, and both specifications are hereby fully incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of data processing. More specifically, the present invention relates to the employment of multiple programming languages interleaved within a single source file for data processing operations.

2. Background Information

Ever since the invention of the first computer, computer scientists have continuously tried to improve the productivity of programmers, such that more applications can be developed using fewer resources to take advantage of the continuous advancements being made in the art of computer and related technologies. First assembler languages were developed to replace machine languages. Then, high level languages, such as FORTRAN, COBOL, PL/I and so forth, were developed to further improve the productivity of programmers. Development of high level languages were followed by structured languages such as Pascal and C, and then object oriented programming languages such as C++. To facilitate development of the Internet and the World Wide Web, "new" languages such as the Hypertext Markup Language (HTML), Java, Javascript, Perl and CGI were developed.

Each programming language has its strength and weakness, and is

often suitable for certain applications over other applications. It is often desirable to be able to employ instructions or statements of different programming languages to solve a problem or implement an application. However, few programming languages offer such support. To the extent that mixed language execution is supported, the approach is often proprietary and not extendable to other programming languages. Thus, an improved mixed multi-language method, especially, one that is extensible to multiple programming languages is desired.

SUMMARY OF THE INVENTION

A data processing representation is expressed in the form of code sections, which may be nested, using multiple programming languages. The representation is read by an execution engine. The execution engine identifies the programming language of each code section, and a corresponding language specific processing unit is invoked to process the code section. The language specific processing unit reads that section of the representation, identifying sub-sections specified in it's associated language and other sub-sections specified in unknown languages. It executes the sub-sections specified in its associated language with the intended semantics and in the appropriate order. When a sub-section specified in an unknown language is encountered, it delegates processing of that sub-section back to the execution engine, which repeats this process for the unknown sub-section. The execution engine coordinates execution of the unknown sub-section, using one or more appropriate language specific processing units, and returns the result back to the requesting language specific processor, which will continue processing where it left off.

In one embodiment, a header section comprising directive and/or declarative statement is also supported for one or more of the languages. Upon recognition, the corresponding language specific processing unit imports data packages enumerated by the directive statement, as directed, or instantiate methods/variables enumerated by the declarative statement, for code sections of the language, as declared.

In one embodiment, the mixed usage of at least three programming languages is supported. The first language is an XML-like declarative language, the second language is the Java language and the third language is XML.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

Figure 1 illustrates an overview of the multi-language execution method of the present invention, in accordance with one embodiment;

Figure 2a illustrates the relevant operational flow of the execution engine of **Fig. 1**, in accordance with one embodiment;

Figure 2b illustrates the relevant operational flow of a language specific processing unit of **Fig. 1**, for processing a code section of the language, in accordance with one embodiment;

Figure 2c illustrates the relevant operational flow of a language specific processing unit of **Fig. 1**, for processing a header section of the language, in accordance with one embodiment;

Figure 3 illustrates a computer system suitable for use to practice the present invention, in accordance with one embodiment; and

Figure 4 illustrates a multi-language data processing representation of **Fig. 1**, in further detail in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

The present invention includes a method for specifying data processing operations using programming instructions of multiple programming languages, and for executing the multi-language data processing representation.

In the following description, various aspects of the present invention will be described. However, the present invention may be practiced with only some

or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, the present invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

Parts of the description will be presented in data processing terms, such as data, variables, methods, import, retrieve, return, and so forth, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, these quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical, electrical and/or optical components of a computer system. The term computer system includes general purpose as well as special purpose data processing machines, systems, and the like, that are standalone, adjunct or embedded.

Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation.

The phrase "in one embodiment" is used repeatedly. The phrase generally does not refer to the same embodiment, however, it may.

Overview

Referring now to **Figure 1**, wherein a block diagram illustrating an overview of the multi-language execution method of the present invention, in accordance with one embodiment. As illustrated, in accordance with the present invention, a computing environment **102** is provided with an execution engine **104**, supplemented with a number of language specific processing units **105**, to facilitate execution of data processing representations **106** expressed with programming instructions of multiple programming languages. For the

embodiment, computing environment **102** is also provided with function libraries **112** of the programming languages.

As illustrated, in accordance with the embodiment, a multi-language data processing representation **106** includes one or more language namespace declarations **108** declaring language or languages employed, and one or more code sections **110** of the declared languages. In other embodiments, other non-namespace means may also be employed to declare the languages involved. As will be described in more detail below, each code section **110** may include sub-sections written in one or more other languages, that is code sections **110** of the different programming languages may be interleaved. Each sub-section may in turn have sub-sub-sections written in other languages, and so forth.

For the embodiment, data processing representation **106** may also include one or more language specific header sections **109** specifying various "preliminary" matters for subsequent code sections **110** of the language.

Execution engine **104** is endowed with logic to anticipate that data processing representations **106** may include code sections of different programming languages, and with the assistance of language specific processing units **105** be able to handle and facilitate execution of these code sections of different programming languages. Moreover, execution engine **104** is endowed with logic to anticipate and handle inter-mixing of code sections of the different programming languages. For the embodiment, upon encountering a code section/statement of a language, execution engine **104** invokes the corresponding language specific processing unit **105** to augment and provide the language specific processing required to process and facilitate execution of the code section/statement.

Language specific processing units **105** are endowed with logic to identify sub-sections written in unknown programming languages, and delegate the processing of those sub-sections back to the execution engine **104**. The execution engine **104**, in turn, will pass the sub-section to an appropriate language specific processor and return the result to the requesting language specific processing unit **105**.

In general, except for the teachings of the present invention incorporated in execution engine **104** and language specific processing units **105**, and the exploitation of these abilities by data processing representations **106**, data processing representations **106** are intended to represent a broad range of data processing representation methodologies known in the art, and execution engine **104** is intended to represent a broad range of the corresponding engines in support of these methodologies. Further, computing environment **102** may be disposed in a single or multi-processor system, or a collection of networked systems. In the case of networked systems, the systems may be networked locally, or across a number of private and/or public networks, including the Internet.

Mixed Language Data Processing Representation

Referring now to **Figure 4**, wherein a block diagram illustrating a mixed language data process representation **106** of **Fig. 1** in further details, in accordance with one embodiment is shown. As illustrated, and described earlier, for the embodiment, data processing representation **106** includes one or more language namespace declarations **108** declaring one or more languages employed. In one embodiment, declarations **108** are expressed in accordance with the following exemplary syntax:

<xs:xsheet xmlns:xs="xl://crossgain.net/lang/xsheet/"
xmlns:java="xl://crossgain.net/lang/java/">

where "xmlns" declares an XML namespace,

"xl://crossgain.net/lang/xsheet/" is a namespace using a specially formed URI identifying one language that may be used in this source. The execution engine uses this URI to locate an appropriate language specific processing unit for sections written in this language.

"xl://crossgain.net/lang/java/" is a specially formed URI identifying a second language that may be used in this source (an extension of the well known Java language in this example). The execution engine uses this URI to locate an appropriate

language specific processing unit for sections written in this language.

"xs" is a namespace prefix used to identify sections of the source written in the language identified by the associated namespace, "xl://crossgain.net/lang/xsheet/"

"java" is a namespace prefix used to identify sections of the source written in the language identified by the associated namespace, "xl://crossgain.net/lang/java/"

Cell based data processing is described in U.S. patent application number 09/741,219, entitled "Cell Based Data Processing", filed on December 19, 2000, which is a non-provisional application of the earlier enumerated U.S. provisional patent application 60/246,915. Readers are referred to the '219 application for further details.

For ease of understanding, the remaining description of the present invention will be presented primarily in the context of the aforementioned "cell based" methodology/language and the extension of the Java language, the present invention is not so limited. The present invention may be practiced with any two or more currently known or to be developed languages, as long as each of the languages is amenable to the declaration and reference techniques described in further details below.

Continuing to refer to **Fig. 4**, and as alluded earlier, for the embodiment, data processing representation **106** further includes a number of language specific header sections **109** of selected supported languages. For the embodiment, each header section **109** may include one or more directive statements **402** directing one or more preliminary or preparatory actions, such as importing of data packages, to be performed, and one or more declarative statements **404** declaring one or more processing methods or instance variables to be instantiated for use by subsequent code sections **110** of the language.

In one embodiment, a header section **109** may be declared in accordance with the following exemplary syntax:

<xs:header>

```
<java:directive>
    import org.w3c.dom.*;
</java:directive>
</xs:header>
```

The above example directive directs the import of W3C's definition of the document object model for use by subsequent Java code sections.

Still referring to **Fig. 4.** as described earlier, data processing section **106** further includes language specific as well as mixed language code sections **110a** and **110b**. For the embodiment, statements of a second language may be intermixed among statement of a first language, employing one or more sets of delimiting language tag pairs **442a-442b** and **444a-444b** as shown.

For example, from within Java, retrieval and return of a XML value associated with an xsheet variable as an object may be specified as follows:

```
myvar = <xs:valueof select="$countdown"/>;
```

The XML value identified by the current value of the xsheet variable "countdown" is retrieved and returned as an object for use in a Java expression. In contrast, consider the following example where the xsheet code is used as a statement instead of part of an expression:

```
for (int j = 0; j < 10; j++) {
        <xs:value-of select="$countdown"/>;
}
```

In this case, the Java specific processing unit asks the execution engine to evaluate the xsheet code 10 times. Each time, the results returned by the execution engine are appended to the output of the delimited code section.

As illustrated, for the embodiment, statements within the delimited code section may also invoke one or more local, remote or built-in library functions of the language. In one embodiment, the built-in library functions supported for the example Java language include

a) an emit() function for converting Java Objects to XML form and appending the resulting value of the function to output of the delimited code section;

b) a push(element) function to append a copy of a specified element to the output of the delimited code section and reposition the insertion point for the delimited code section inside the element such that subsequent output of the delimited code section is appended as children of this element;

c) a pop() function to "back up" the current insertion point for the delimited code section such that subsequent output of the delimited code section is appended as children of the parent of the element containing the current insertion point; and

d) a getDocument()function to retrieve and return a W3C document object for the delimited code section, for use as a space in which new nodes may be created.

Execution Engine

Figure 2a illustrates the operational flow of the relevant aspects of execution engine **104** in accordance with one embodiment; more specifically, the operational flow of execution engine **104** for processing data processing representation **106**. The embodiment, assumes, execution engine **104**, like other conventional execution engines of prior art data processing representations, upon invocation, would parse and interpret the statements of data processing representation **106**.

As illustrated, for the embodiment, execution engine **104** first locates and processes the declaration statements declaring the programming languages employed in expressing the data processing representation being processed, block **202**. Next, execution engine **104** locates the start of the "next" code section, identifies the language associated with code section, and as described earlier, invoke the corresponding language specific processing unit to process the code section, block **204**.

Upon return of execution control, execution engine **104** determines whether end of execution has been reached, block **208**, if not, execution engine **104** continues the process at block **204** again, i.e. determining the language of the "next" code section, and invoke the corresponding language specific processing unit to process the "next" code section.

The process continues until eventual execution control is returned where end of execution has been reached.

Language Specific Processing Unit

Figure 2b illustrates the operational flow of the relevant aspects of a language specific processing unit **105** for processing a non-header code section of the language, in accordance with one embodiment. As illustrated, for the embodiment, the processing unit first locates the "next" statement to be executed, block **222**. Upon locating the "next" statement, the processing unit determines if the it is a statement of the language or of an unknown language (e.g. the start of a language tag of a sub-section of another language), block **224**. If it is a statement of an unknown language, as described earlier, the processing unit invokes the execution engine recursively allowing it to evaluate the foreign language section with the other language specific processing units at its disposal.

If it is a statement of the language the language processor the statement elements accordingly, starting with a next statement element, block **226**. Again, the processing unit determines if the statement element is an element recognized within the language or it's an element of an unknown language (e.g. the start of a language tag of a sub-section of another language), block **228**. If it is an element of an unknown language, as described earlier, the processing unit invokes the execution engine recursively.

If it is an element recognized by the language, the processing unit processes the element accordingly, block **230**. As described earlier, in one embodiment, the language element may be an invocation invoking a library function of the language. If so, the library function is invoked and executed accordingly. The library function may be local or remote, and invoked in a namespace based approach. Invocation of function in a namespace based approach is the subject matter of Patent Cooperation Treaty (PCT) patent application number <to be insert>, entitled "Namespace Based Function Invocation", contemporaneously filed, and published on <insert date>, which claims priority to the earlier enumerated U.S. provisional patent application 60/246,916. Readers are referred to the 'xxx application for further details.

Still referring to **Fig. 2b**, thereafter, at block **232**, the processing unit determines if end of statement has been reached. If not, it continues operation at block **226** again. If end of statement has been reached, the processing unit determines if there are additional statements to be processed, block **234**. If so, it continues operation at block **222** again. Otherwise, it returns execution control back to the execution engine.

Figure 2c illustrates the operational flow of the relevant aspects of a language specific processing unit **105** for processing a header section of the language, in accordance with one embodiment. More specifically, the embodiment is the embodiment in support of the Java language, incorporating the earlier described features. Other language specific processing units **105** in support of other languages may be likewise implemented with or without modifications and alterations.

As illustrated, upon invocation, the exemplary processing unit **105** determines if it is processing a directive or a declarative statement, block **232**. If it is a directive statement being processed, the exemplary processing unit **105** performs the specified operation, e.g. an import operation importing enumerated data packages, as directed, block **234**. On the other hand, if it is a declarative statement being processed, the exemplary processing unit **105** processes the declaration, e.g. instantiating a declared processing method or an instance variable, as declared, block **236**.

The process continues as earlier described, block **238**, until all statements of the header section are processed.

Example Computer System

Figure 3 illustrates a computer system suitable for use to practice the present invention, in accordance with one embodiment. As shown, computer system **300** includes one or more processors **302** and system memory **304**. Additionally, computer system **300** includes mass storage devices **306** (such as diskette, hard drive, CDROM and so forth), input/output devices **308** (such as keyboard, cursor control and so forth) and communication interfaces **310** (such as network interface cards, modems and so forth). The elements are

coupled to each other via system bus **312**, which represents one or more buses. In the case of multiple buses, they are bridged by one or more bus bridges (not shown). Each of these elements performs its conventional functions known in the art. In particular, system memory **304** and mass storage **306** are employed to store a working copy and a permanent copy of the programming instructions implementing the execution engine and the language specific processing units. The permanent copy of the programming instructions may be loaded into mass storage **306** in the factory, or in the field, through a distribution medium (not shown) or through communication interface **310** (from a distribution server (not shown). The constitution of these elements **302-312** are known, and accordingly will not be further described.

Conclusion and Epilogue

Thus, it can be seen from the above descriptions, a novel method and apparatus for processing and facilitating execution of data processing representations encoded using multiple programming languages has been described. While the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of restrictive on the present invention.

CLAIMS

What is claimed is:

1. A method of computing comprising:

reading a data processing representation having code sections with code statements of at least a first and a second programming language;

recognizing a first code section with at least code statements of a first programming language;

invoking a first code statement processing unit of the first programming language to process the first code section;

recognizing a second code section with at least code statements of a second programming language;

invoking a second code statement processing unit of the second programming language to process the second code section.

2. The method of claim 1, wherein the first and second code sections are non-overlapping code sections.

3. The method of claim 1, wherein said second code section is embedded within said first code section.

4. The method of claim 1, wherein said first language is a directive language, and said second language is a selected one of XML and Java.

5. The method of claim 1, wherein said first language is Java, and said second language is XML.

6. The method of claim 1, wherein the method further comprises

recognizing a third code section with at least code statements of a third programming language;

invoking a third code statement processing unit of the third programming language to process the third code section.

7. The method of claim 6, wherein said third code section is embedded within said second code section, and said second code section is embedded within said first code section.

8. The method of claim 6, wherein said first language is a directive language, said second language is Java and said third language is XML.

9. The method of claim 1, wherein the method further comprises

recognizing an invocation of a library function within at least a selected one of said first and second code sections;

invoking the library function, and outputting the result of the invocation.

10. The method of claim 9, wherein the library function is a selected one of an emit function for outputting execution results, a pop function for returning an element, and a push function for backing up an insertion point.

11. The method of claim 1, wherein the method further comprises

recognizing a header section of a selected one of the first and the second programming language;

recognizing a directive statement within the header section, enumerating one or more data packages; and

importing the enumerated one or more data packages for use within code sections with at least statements of the selected first and second programming language.

12. The method of claim 1, wherein the method further comprises

recognizing a header section of a selected one of the first and the second programming language;

recognizing a declare statement within the header section, enumerating one or more processing methods; and

instantiating the enumerated one or more processing methods for use within code sections with at least statements of the selected first and second programming language.

13. The method of claim 1, wherein the method further comprises

recognizing a header section of a selected one of the first and the second programming language;

recognizing a declare statement within the header section, enumerating one or more instance variables; and

instantiating the enumerated one or more instance variables for use within code sections with at least statements of the selected first and second programming language.

14. A method of computing comprising:

reading a data processing representation having code sections with code statements of at least a first and a second programming language;

recognizing a header section of a selected one of the first and the second programming language;

recognizing a directive statement within the header section, enumerating one or more data packages; and

importing the enumerated one or more data packages for use by code sections within code sections with at least statements of the selected first and second programming language.

15. The method of claim 14, wherein the method further comprises

recognizing a declare statement within the header section, enumerating one or more processing methods; and

instantiating the enumerated one or more processing methods for use within code sections with at least statements of the selected first and second programming language.

16. The method of claim 14, wherein the method further comprises

recognizing a declare statement within the header section, enumerating one or more instance variables; and

instantiating the enumerated one or more instance variables for use within code sections with at least statements of the selected first and second programming language.

17. A method of computing comprising:

reading a data processing representation having code sections with code statements of at least a first and a second programming language;

recognizing a header section of a selected one of the first and the second programming language;

recognizing a first declare statement within the header section, enumerating one or more processing methods; and

instantiating the enumerated one or more processing methods for use within code sections with at least statements of the selected first and second programming language.

18. The method of claim 17, wherein the method further comprises

recognizing a second declare statement within the header section, enumerating one or more instance variables; and

instantiating the enumerated one or more instance variables for use within code sections with at least statements of the selected first and second programming language.

19. A method of computing comprising:

reading a data processing representation having code sections with code statements of at least a first and a second programming language;

recognizing a header section of a selected one of the first and the second programming language;

recognizing a declare tement within the header section, enumerating one or more instance variables; and

instantiating the enumerated one or more instance variables for use within code sections with at least statements of the selected first and second programming language.

20. An apparatus comprising:

at least one storage unit having stored thereon programming instructions designed to enable the apparatus to

read a data processing representation having code sections with code statements of at least a first and a second programming language,

recognize a first code section with code statements of at least the first programming language,

invoking a first code statement processing unit of the first programming language to process the first code section,

recognize a second code section with code statements of at least the second programming language,

invoking a second code statement processing unit of the second programming language to process the second code section; and

at least one processor coupled to said at least one storage unit to execute said programming instructions.

21. The apparatus of claim 20, wherein the first and second code sections are non-overlapping code sections.

22. The apparatus of claim 20, wherein said second code section is embedded within said first code section.

23. The apparatus of claim 20, wherein said first language is a directive language, and said second language is a selected one of XML and Java.

24. The apparatus of claim 20, wherein said first language is Java, and said second language is XML.

25. The apparatus of claim 20, wherein the programming instructions further enable the apparatus to

recognize a third code section with at least code statements of a third programming language;

invoke a third code statement processing unit of the third programming language to process the third code section.

26. The apparatus of claim 25, wherein said third code section is embedded within said second code section, and said second code section is embedded within said first code section.

27. The apparatus of claim 25, wherein said first language is a directive language, said second language is Java and said third language is XML.

28. The apparatus of claim 20, wherein said programming instructions further enable the apparatus to

recognize an invocation of a library function of a selected one of the first and the second programming language within the first code section,

invoke the library function, and output the result of the invocation.

29. The apparatus of claim 28, wherein the library function is a selected one of an emit function for outputting execution results, a pop function for returning an element, and a push function for backing up an insertion point.

30. The apparatus of claim 20, wherein the said programming instructions are further designed to enable the apparatus to

recognize a header section of a selected one of the first and the second programming language;

recognize a directive statement within the header section, enumerating one or more data packages; and

import the enumerated one or more data packages for use by code sections with at least code statements of the selected one of the first and the second programming language.

31. The apparatus of claim 20, wherein said programming instructions are further designed to enable the apparatus to

recognize a header section of a selected one of the first and the second programming language;

recognize a declare statement within the header section, enumerating one or more processing methods; and

instantiate the enumerated one or more processing methods for use within code sections with at least code statements of the selected one of the first and the second programming language.

32. The apparatus of claim 20, wherein said programming instructions are further designed to enable the apparatus to

recognize a header section of a selected one of the first and the second programming language;

recognize a declare statement within the header section, enumerating one or more instance variables; and

instantiate the enumerated one or more instance variables for use code sections with at least code statements of the selected one of the first and the second programming language.

33. An apparatus comprising:

at least one storage medium having stored therein a plurality of programming instructions designed to enable the apparatus to

read a data processing representation having code sections with programming language statements of at least a first and a second programming language,

recognize a header section of a selected one of the first and the second programming language;

recognizing a directive statement within the header section, enumerating one or more data packages, and

import the enumerated one or more data packages for use code sections with at least code statements of the selected one of the first and the second programming language; and

at least one processor coupled to the storage medium to execute the programming instructions.

34. The apparatus of claim 33, wherein said programming instructions are further designed to enable the apparatus to

recognize a declare statement within the header section, enumerating one or more processing methods, and

instantiate the enumerated one or more processing methods for use within code sections with at least code statements of the selected one of the first and the second programming language.

35. The apparatus of claim 33, wherein said programming instructions are further designed to enable the apparatus to

recognize a declare statement within the header section, enumerating one or more instance variables, and

instantiate the enumerated one or more instance variables for use within code sections with at least code statements of the selected one of the first and the second programming language.

36. An apparatus comprising:

at least one storage medium having stored therein a plurality of programming instructions designed to enable the apparatus to

read a data processing representation having code sections with code statements of at least a first and a second programming language,

recognize a header section of a selected one of the first and the second programming language,

recognize a first declare statement within the header section, enumerating one or more processing methods, and

instantiate the enumerated one or more processing methods for use within code sections with at least code statements of the selected one of the first and the second programming language; and

at least one processor coupled to the storage medium to execute the programming instructions.

37. The apparatus of claim 36, wherein said programming instructions are further designed to enable the apparatus to

recognize a second declare statement within the header section, enumerating one or more instance variables, and

instantiate the enumerated one or more instance variables for use within code sections with at least code statements of the selected one of the first and the second programming language.

38. An apparatus comprising:

at least one storage medium having stored therein a plurality of programming instructions designed to enable the apparatus to

read a data processing representation having code sections with code statements of at least a first and a second programming language,

recognize a header section of a selected one of the first and the second programming language,

recognize a declare statement within the header section, enumerating one or more instance variables,

instantiate the enumerated one or more instance variables for use within code sections with at least code statements of the selected one of the first and the second programming language; and

at least one processor coupled to the storage medium to execute the programming instructions.

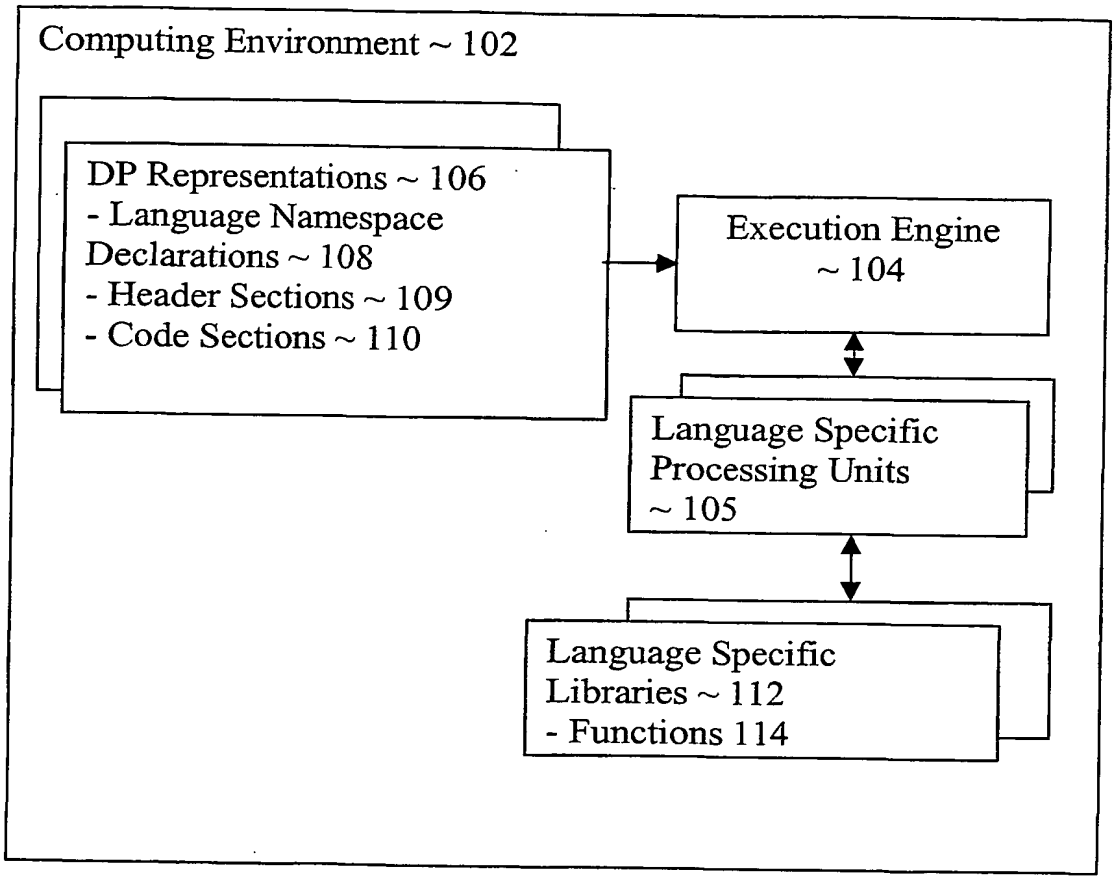
Computing Environment ~ 102
DP Representations ~ 106
- Language Namespace Declarations ~ 108
- Header Sections ~ 109
- Code Sections ~ 110
Execution Engine ~ 104
Language Specific Processing Units ~ 105
Language Specific Libraries ~ 112
- Functions 114

Figure 1

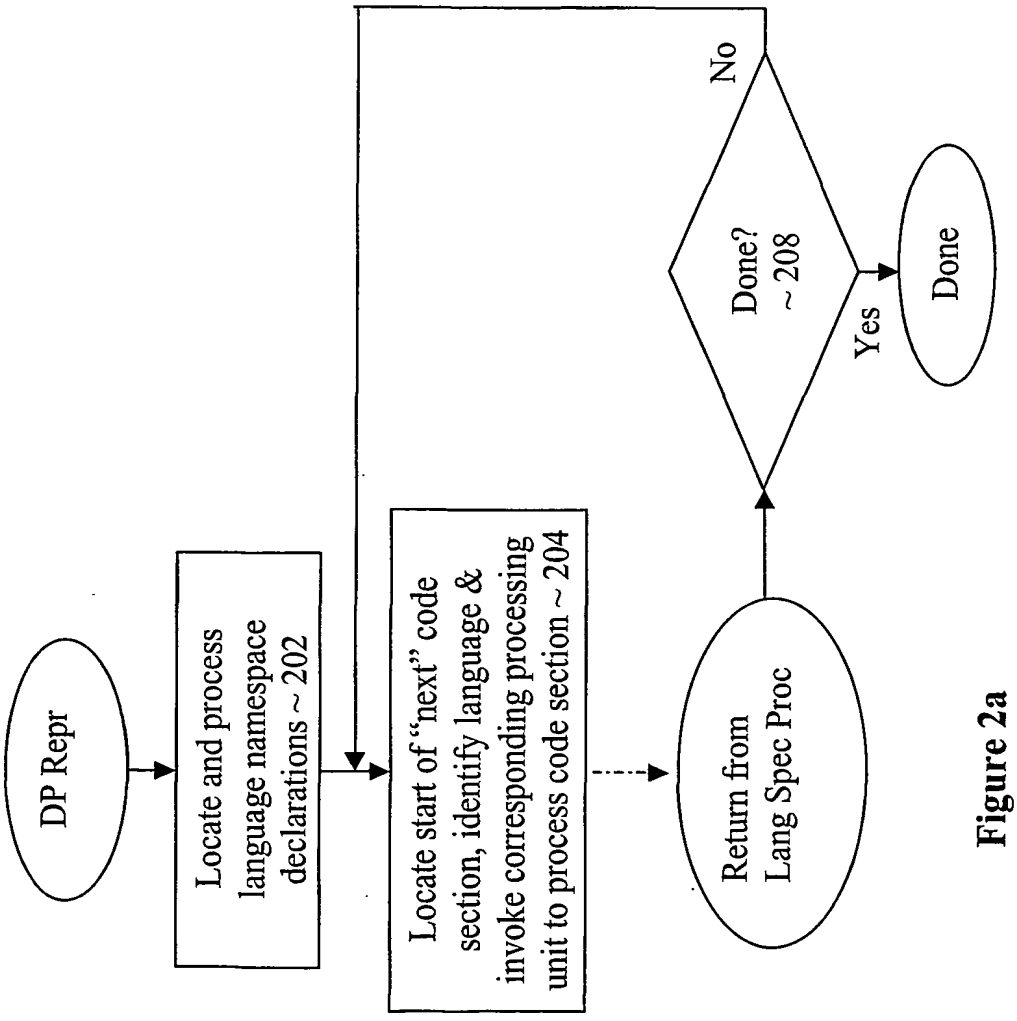
DP Repr
Locate and process language namespace declarations ~ 202
Locate start of "next" code section, identify language & invoke corresponding processing unit to process code section ~ 204
Return from Lang Spec Proc
Done? ~ 208
No
Yes
Done

Figure 2a

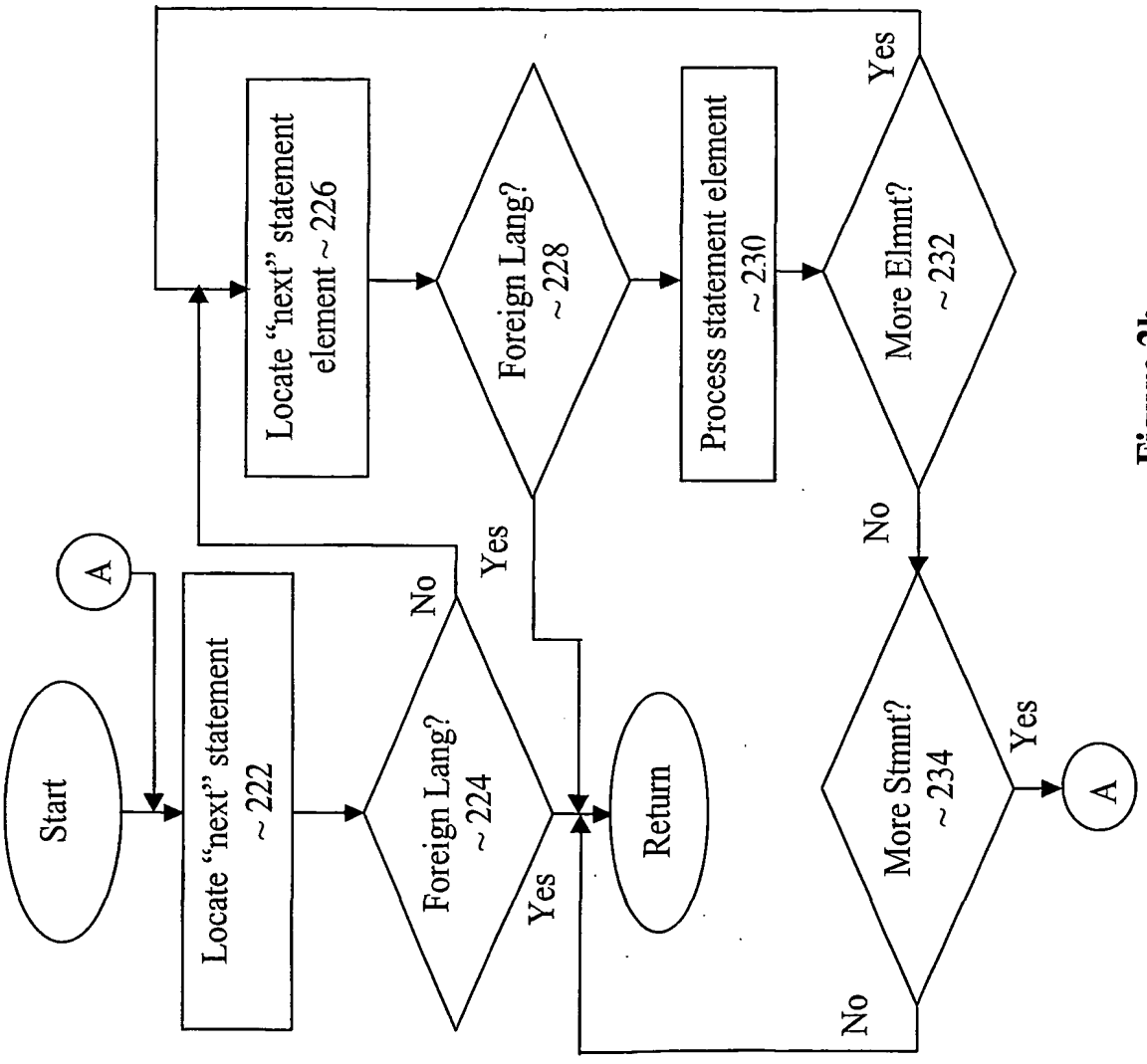
Start
A
Locate "next" statement ~ 222
Foreign Lang? ~ 224
No
Yes
Return
Locate "next" statement element ~ 226
Foreign Lang? ~ 228
Yes
Process statement element ~ 230
More Elmnt? ~ 232
Yes
No
More Stmnt? ~ 234
Yes
No
A

Figure 2b

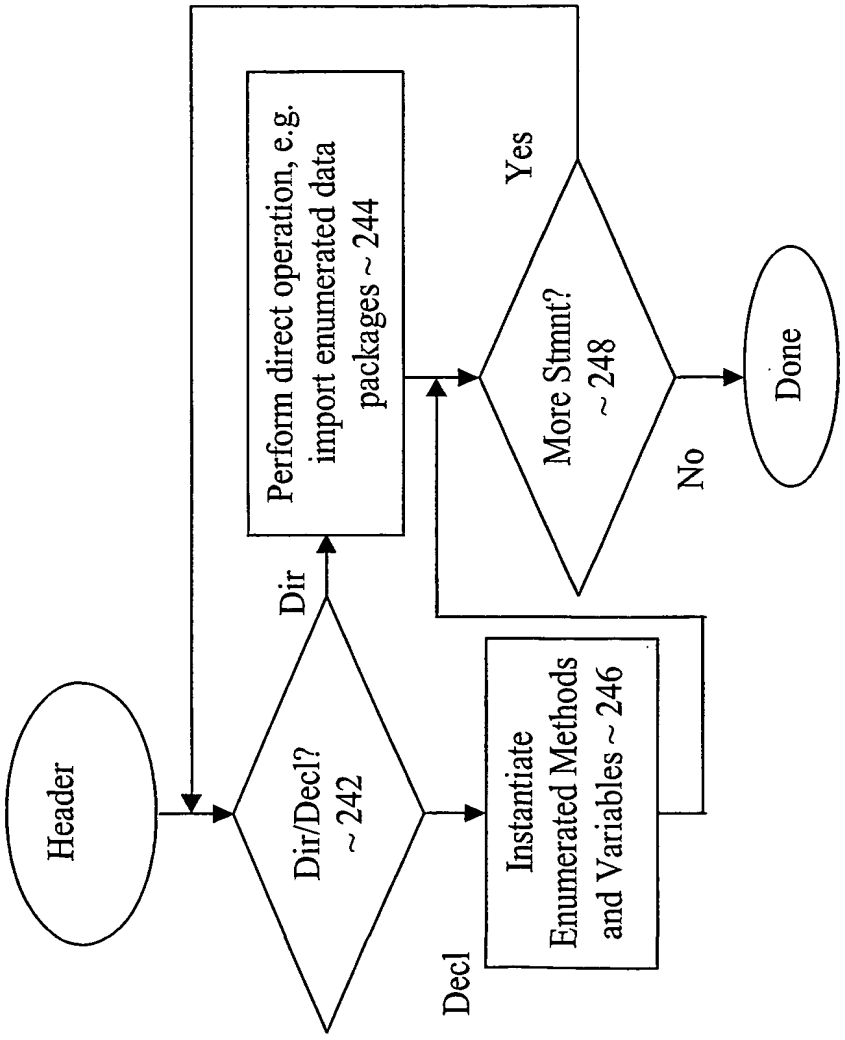
Header
Dir/Decl?
~ 242
Dir
Decl
Perform direct operation, e.g.
import enumerated data
packages ~ 244
Instantiate
Enumerated Methods
and Variables ~ 246
More Stmnt?
~ 248
Yes
No
Done

Figure 2c

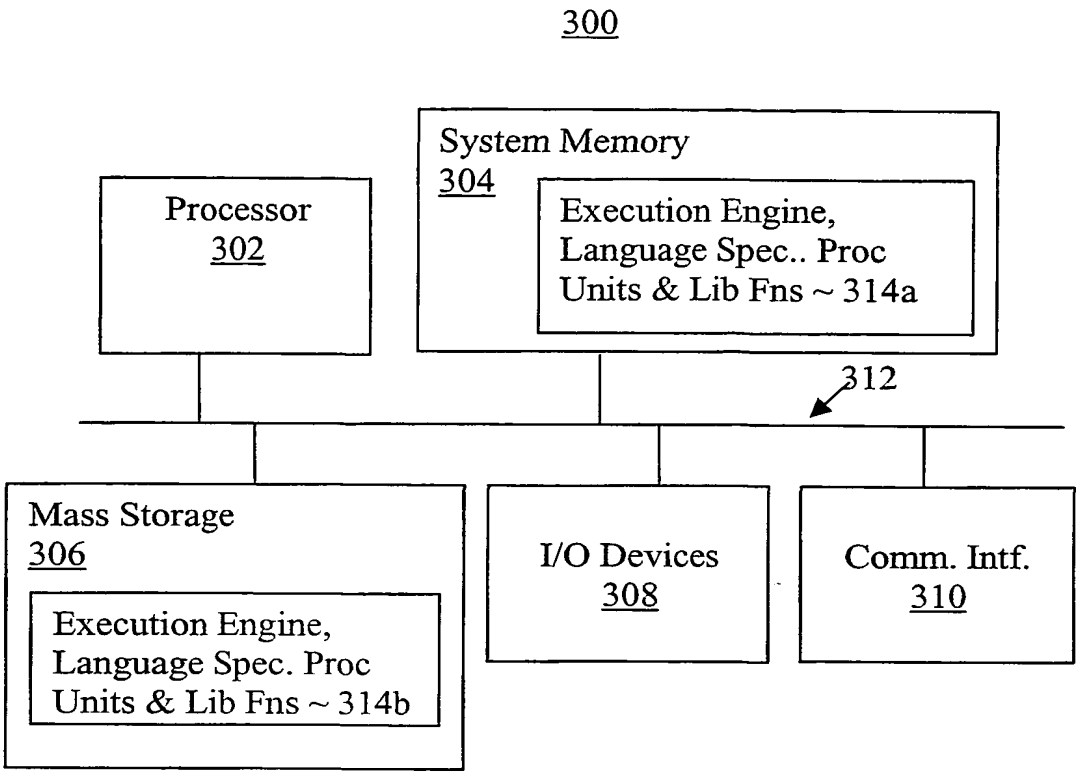
300
System Memory
304
Execution Engine,
Language Spec.. Proc
Units & Lib Fns ~ 314a
Processor
302
312
Mass Storage
306
Execution Engine,
Language Spec. Proc
Units & Lib Fns ~ 314b
I/O Devices
308
Comm. Intf.
310

Figure 3

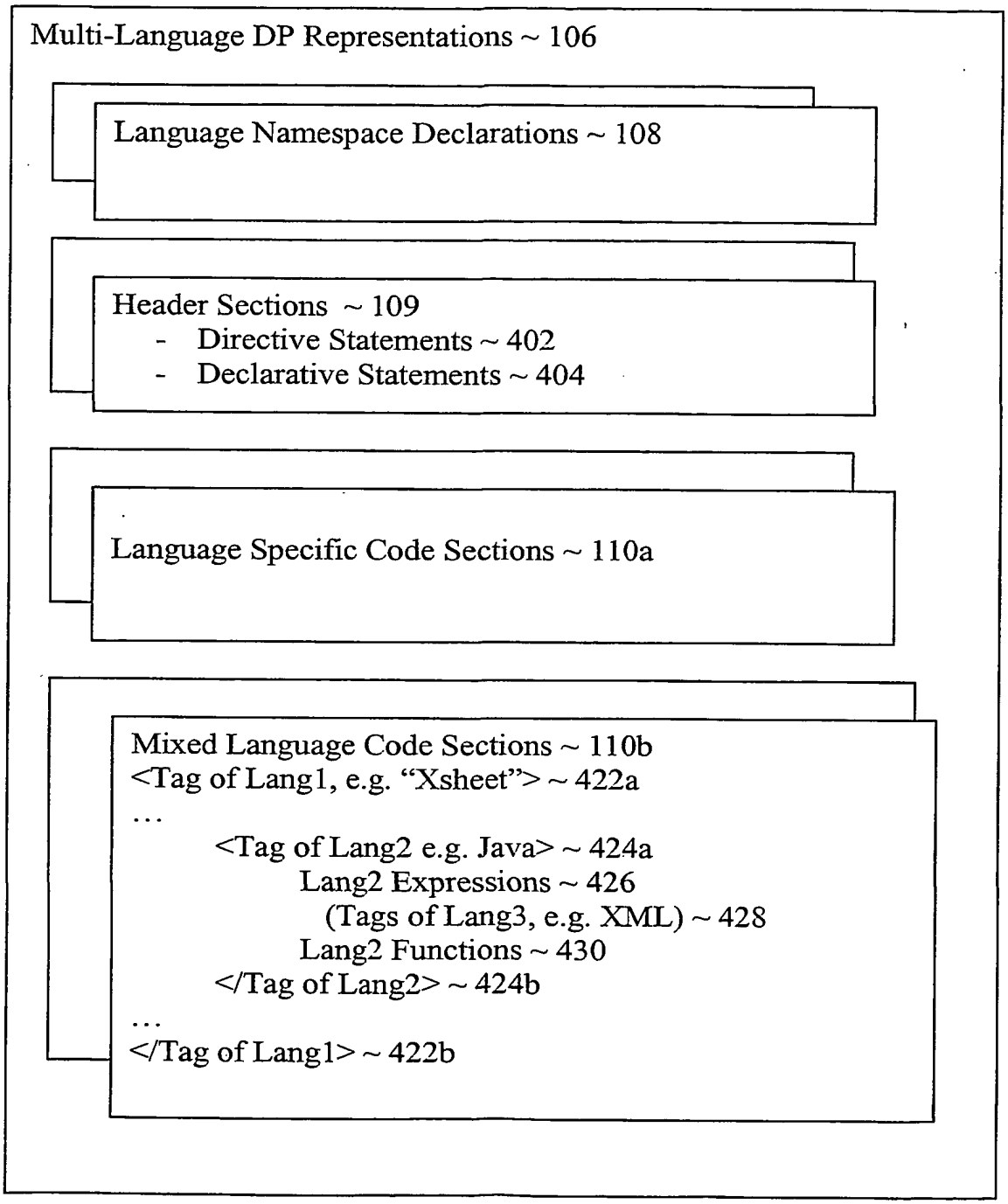
Multi-Language DP Representations ~ 106
Language Namespace Declarations ~ 108
Header Sections ~ 109
- Directive Statements ~ 402
- Declarative Statements ~ 404
Language Specific Code Sections ~ 110a
Mixed Language Code Sections ~ 110b
<Tag of Lang1, e.g. "Xsheet"> ~ 422a
...
<Tag of Lang2 e.g. Java> ~ 424a
Lang2 Expressions ~ 426
(Tags of Lang3, e.g. XML) ~ 428
Lang2 Functions ~ 430
</Tag of Lang2> ~ 424b
...
</Tag of Lang1> ~ 422b

Figure 4

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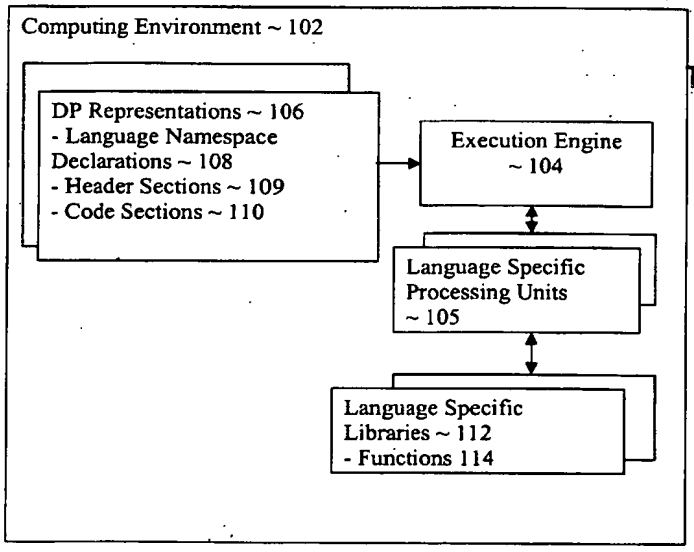
[Continued on next page]

(54) Title: A MULTI-LANGUAGE EXECUTION METHOD



(57) Abstract: A data processing representation (106) is expressed in the form of code sections (110), which may be nested, using multiple programming languages. The representation is read by and execution engine (104). The execution engine indentifies the language of each code section, and a corresponding language specific processing unit (105) is invoked to process the code section. The processing unit reads that section, identifying sub-sections specified in it's associated language and other sub-sections specified in unknown languages. It executes the sub-sections specified in its associated language with the intended in an unknown language is encountered, it delegates processing of that sub-section back to the execution engine, which repeats this process for the unknown sub-section. The execution result is returned back to the requesting language specific processing unit, which continues processing from where it left off.

WO 02/039647 A3

patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/46928

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 9/45

US CL :717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST 1.3 (USPAT; EPO; JPO; DERWENT; IBM_TDB), IEEEXplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US 6,339,839 B1 (WANG) 15 January 2002, Abstract, FIGs. 1-3 & 6, col. 1:12-63, col. 6:33-61, cols. 7-8.	1-38
X,P	US 6,292,936 B1 (WANG) 18 September 2001, Abstract, FIGs. 1-3 & 5, col. 1:12-52, col. 2:17-67, col. 6:16-67.	1-38
A	US 6,066,181 A (DEMASTER) 23 May 2000, FIG. 1 & at col. 2:5-21.	1-38
X	US 5,630,137 A (CARNEY et al) 13 May 1997, FIGs. 1-2 & cols. 5-6.	1-2, 14-21, 33-38
A	WALLACE et al, Haskell and XML: Generic Combinators or Type-Based Translation?, ACM September 1999, pages 148-159. See entire document.	1-2, 14-21, 33-38

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Date of the actual completion of the international search 12 APRIL 2002	Date of mailing of the international search report 09 MAY 2002
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International Application No. PCT/US 01/46928

International Filing Date (09.11.01) 09 NOV 2001

Name of receiving Office and "PCT International Application": PCT INTERNATIONAL APPLICATION RO/US

Applicant's or agent's file reference *(if desired) (12 characters maximum)*: 41016.P009

Box No. I TITLE OF INVENTION

A MULTI-LANGUAGE EXECUTION METHOD

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☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

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This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

AUYEUNG, Aloysius T.C.
COLUMBIA IP LAW GROUP, PC
10260 SW Greenburg Road, Suite 820
Portland, Oregon 97223
United States of America

Telephone No.
(503) 595-2800

Facsimile No.
(503) 595-2804

Teleprinter No.

Agent's registration No. with the Office
35,432

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BAU, David III
415 Howard Road
Gladwyne, Pennsylvania 19035
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: ~~United States~~ US

State *(that is, country)* of residence: ~~United States~~ US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

VASILIK, Kenneth Eric
4911 163rd Ave., NE
Redmond, Washington 98052
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: ~~United States~~ US

State *(that is, country)* of residence: ~~United States~~ US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

RO/US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

SCHNEIDER, John C.
17003 NE 28th Place
Bellevue, Washington 98008
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: United States US

State *(that is, country)* of residence: United States US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES *Mark the applicable check-boxes below; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

- ☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **MZ** Mozambique, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH & LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, **TR** Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ **AE** United Arab Emirates
- ☒ **AG** Antigua and Barbuda
- ☒ **AL** Albania
- ☒ **AM** Armenia
- ☒ **AT** Austria
- ☒ **AU** Australia
- ☒ **AZ** Azerbaijan
- ☒ **BA** Bosnia and Herzegovina
- ☒ **BB** Barbados
- ☒ **BG** Bulgaria
- ☒ **BR** Brazil
- ☒ **BY** Belarus
- ☒ **BZ** Belize
- ☒ **CA** Canada
- ☒ **CH & LI** Switzerland and Liechtenstein
- ☒ **CN** China
- ☒ **CO** Colombia
- ☒ **CR** Costa Rica
- ☒ **CU** Cuba
- ☒ **CZ** Czech Republic
- ☒ **DE** Germany
- ☒ **DK** Denmark
- ☒ **DM** Dominica
- ☒ **DZ** Algeria
- ☒ **EC** Ecuador
- ☒ **EE** Estonia
- ☒ **ES** Spain
- ☒ **FI** Finland
- ☒ **GB** United Kingdom
- ☒ **GD** Grenada
- ☒ **GE** Georgia
- ☒ **GH** Ghana
- ☒ **GM** Gambia
- ☒ **HR** Croatia
- ☒ **HU** Hungary
- ☒ **ID** Indonesia
- ☒ **IL** Israel
- ☒ **IN** India
- ☒ **IS** Iceland
- ☒ **JP** Japan
- ☒ **KE** Kenya
- ☒ **KG** Kyrgyzstan
- ☒ **KP** Democratic People's Republic of Korea
- ☒ **KR** Republic of Korea
- ☒ **KZ** Kazakhstan
- ☒ **LC** Saint Lucia
- ☒ **LK** Sri Lanka
- ☒ **LR** Liberia
- ☒ **LS** Lesotho
- ☒ **LT** Lithuania
- ☒ **LU** Luxembourg
- ☒ **LV** Latvia
- ☒ **MA** Morocco
- ☒ **MD** Republic of Moldova
- ☒ **MG** Madagascar
- ☒ **MK** The former Yugoslav Republic of Macedonia
- ☒ **MN** Mongolia
- ☒ **MW** Malawi
- ☒ **MX** Mexico
- ☒ **MZ** Mozambique
- ☒ **NO** Norway
- ☒ **NZ** New Zealand
- ☒ **PL** Poland
- ☒ **PT** Portugal
- ☒ **RO** Romania
- ☒ **RU** Russian Federation
- ☒ **SD** Sudan
- ☒ **SE** Sweden
- ☒ **SG** Singapore
- ☒ **SI** Slovenia
- ☒ **SK** Slovakia
- ☒ **SL** Sierra Leone
- ☒ **TJ** Tajikistan
- ☒ **TM** Turkmenistan
- ☒ **TR** Turkey
- ☒ **TT** Trinidad and Tobago
- ☒ **TZ** United Republic of Tanzania
- ☒ **UA** Ukraine
- ☒ **UG** Uganda
- ☒ **US** United States of America
- ☒ **UZ** Uzbekistan
- ☒ **VN** Viet Nam
- ☒ **YU** Yugoslavia
- ☒ **ZA** South Africa
- ☒ **ZW** Zimbabwe

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ ..... ☐ ..... ☐ .....

☐ ..... ☐ ..... ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. *If, in any of the Boxes, except Boxes Nos. VIII(i) to (v) for which a special continuation box is provided, **the space is insufficient** to furnish all the information: in such case, write "Continuation of Box No...." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

   (i) ***if more than two persons are to be indicated as applicants and/or inventors** and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

   (ii) *if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

   (iii) *if, in Box No. II or in any of the sub-boxes of Box No. III, **the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America**: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

   (iv) *if, in addition to the agent(s) indicated in Box No. IV, there are **further agents**: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

   (v) *if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V, the name of the United States of America is accompanied by an indication **"continuation"** or **"continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

   (vi) *if, in Box No. VI, there are **more than five earlier applications whose priority is claimed**: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

2. *If, with regard to the **precautionary designation statement** contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

Continuation of Box No. IV:
CHANG, Robert H., Reg. No. 48,765
DIEHL, Robert A., Reg. No. 40,992
KLINDTWORTH, Jason K., Reg. No. 47,211
WATT, Robert T., Reg. No. 45,890
WERNER, Raymond J., Reg. No. 34,752
(All are located at the same address, telephone number and facsimile number as indicated in Box No. IV.)

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1) 10 November 2000 (10.11.00)	60/246,915	US		
item (2) 10 November 2000 (10.11.00)	60/246,916	US		
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☒ item (1) ☒ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

** Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* ....

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA / US .....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*: Number of declarations

☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

Sheet No. ...6...

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application **contains**:

(a) the following number of **sheets in paper form**:

request (including declaration sheets)	:	6
description (excluding sequence listing part)	:	12
claims	:	9
abstract	:	1
drawings	:	6
Sub-total number of sheets	:	34
sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)*	:	
Total number of sheets	:	34

(b) sequence listing part of description filed in **computer readable form**

(i) ☐ only (under Section 801(a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*: .....

This international application is **accompanied by** the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:

	Number of items
1. ☒ fee calculation sheet	:
2. ☐ original separate power of attorney	:
3. ☐ original general power of attorney	:
4. ☒ copy of general power of attorney; reference number, if any:	:
5. ☐ statement explaining lack of signature	:
6. ☐ priority document(s) identified in Box No. VI as item(s):	:
7. ☐ translation of international application into *(language)*:	:
8. ☐ separate indications concerning deposited microorganism or other biological material	:
9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))	
(i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application)	:
(ii) ☐ *(only where check-box (b)(i) or (b)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter*	:
(iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column	:
10. ☒ other *(specify)*: Form PTO-1382	:

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Aloysius T.C. AuYeung

For receiving Office use only (09.11.01)

1. Date of actual receipt of the purported international application: JC14 Rec'd PCT/PTO 09 NOV 2001

2. Drawings:
☐ received:
☐ not received:

3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:

4. Date of timely receipt of the required corrections under PCT Article 11(2):

5. International Searching Authority (if two or more are competent): ISA / US

6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

This sheet is not part of and does not count as a sheet of the international application.

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International Application No. PCT/US 01/46928

(09.11.01) Date stamp of the receiving Office: 09 NOV 2001

Applicant's or agent's file reference: 41016.P009

Applicant: BEA Systems, Incorporated

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE	240 T	240
2. SEARCH FEE	700 S	700

International search to be carried out by: US

(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

Where item (b) of Box No. IX applies, enter **Sub-total number of sheets**
Where item (b) of Box No. IX does not apply, enter **Total number of sheets**: 34

b1 first 30 sheets	382 b1	382
b2 4 (number of sheets in excess of 30) x 9 (fee per sheet) =	36 b2	36
b3 additional component (only if sequence listing part of description is filed in computer readable form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)): 400 x _____ (fee per sheet) =	0 b3	
Add amounts entered at b1, b2 and b3 and enter total at B	418 B	418

Designation Fees

The international application contains 87 designations.

6 (number of designation fees payable *(maximum 6)*) x 82 (amount of designation fee) =	492 D	492
Add amounts entered at B and D and enter total at I	910 I	910

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT *(if applicable)*	0 P	30
5. TOTAL FEES PAYABLE Add amounts entered at T, S, I and P, and enter total in the TOTAL box	USD 1,850 TOTAL	1880

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge deposit account (see below) ☐ postal money order ☐ cash ☐ coupons

☒ cheque ☐ bank draft ☐ revenue stamps ☒ other *(specify)*: Postcard

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT

(This mode of payment may not be available at all receiving Offices)

Receiving Office: RO/ US

Deposit Account No.: 501569

Date: 09 November 2001

Name: Aloysius T.C. AuYeung

Signature: _____

☐ Authorization to charge the total fees indicated above.

☒ *(This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

☐ Authorization to charge the fee for priority document.

PCT
GENERAL POWER OF ATTORNEY
(for several international applications filed under the Patent Cooperation Treaty)
(PCT Rule 90.5)

The undersigned person(s); (Family name followed by given name, for a legal entity, full official designation. The address must include postal code and name of country.)

Robert F. Donohue
Senior Vice President, General Counsel and Secretary
BEA Systems, Inc.
2315 North First Street
San Jose, California 95131
United States of America

● ○

Hereby appoint(s) the following person as ● agent ○ common representative

Name and address
(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country).

AUYEUNG, Aloysius T.C.
DIEHL, Robert A.
KLINDTWORTH, Jason K.
WATT, Robert T.
CHANG, Robert H.
WERNER, Raymond J.

COLUMBIA IP LAW GROUP, PC
10260 SW Greenburg Road, Suite 820
Portland, Oregon 97223
United States of America

To represent the undersigned before
● all the competent International Authorities
○ the International Searching Authority only
○ the International Preliminary Examining Authority only

in connection with any and all international applications filed by the undersigned with the following Office (US) United States as receiving Office and to make or receive payments on behalf of the undersigned.

Signature(s) (where there are several persons, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading this power.

Robert F. Donohue,
Senior Vice President, General Counsel and Secretary

9 Nov 01
Date

PCT
New International Application
Inventory of Unscannable or Missing Items

Serial Number PCT/US 01/46928

Check This Column if Item Is Present	Item	Check This Column if Item Is Missing on Filing
✓	Return Receipt Postcard	
✓	Check (amount $ 1,850.00)	
	PCT EASY Diskette	
	DNA Diskette	
	Exhibit	
✓	Express Mail Label or Envelope	
	Applicant Supplied Priority Document	
	Other (specify)	XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX
XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX	Cover Letter	
XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX	Other (specify)	

Winword/PCT Automation/Unscanned inventory Sep Sheet

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 41016.P009	Date of Mailing *(day/month/year)* 09 MAY 2002 **FOR FURTHER ACTION** **See paragraphs 1 and 4 below**
International application No. PCT/US01/46928	International filing date *(day/month/year)* 09 NOVEMBER 2001
Applicant BEA SYSTEMS INCORPORATED	

1. [X] The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise the applicant must, **within 20 months** from the priority date, perform the presecribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicants's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer TUAN Q. DAM James R. Matthews
Facsimile No. (703) 305-3230	Telephone No. (703) 305-3900

(See notes on accompanying sheet)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 41016.P009	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US01/46928	International filing date *(day/month/year)* 09 NOVEMBER 2001	(Earliest) Priority Date *(day/month/year)* 10 NOVEMBER 2000
Applicant BEA SYSTEMS INCORPORATED		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readable form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (See Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

A data processing representation (106) is expressed in the form of code sections (110), which may be nested, using multiple programming languages. The representation is read by an execution engine (104). The execution engine identifies the language of each code section, and a corresponding language specific processing unit (105) is invoked to process the code section. The processing unit reads that section, identifying sub-sections specified in it's associated language and other sub-sections specified in unknown languages. It executes the sub-sections specified in its associated language with the intended semantics and in the appropriate order. When a sub-section specified in an unknown language is encountered, it delegates processing of that sub-section back to the execution engine, which repeats this process for the unknown sub-section. The execution result is returned back to the requesting language specific processing unit, which continues processing from where it left off.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/46928

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 9/45
US CL :717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST 1.3 (USPAT; EPO; JPO; DERWENT; IBM_TDB), IEEEXplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US 6,339,839 B1 (WANG) 15 January 2002, Abstract, FIGs. 1-3 & 6, col. 1:12-63, col. 6:33-61, cols. 7-8.	1-38
X,P	US 6,292,936 B1 (WANG) 18 September 2001, Abstract, FIGs. 1-3 & 5, col. 1:12-52, col. 2:17-67, col. 6:16-67.	1-38
A	US 6,066,181 A (DEMASTER) 23 May 2000, FIG. 1 & at col. 2:5-21.	1-38
X	US 5,630,137 A (CARNEY et al) 13 May 1997, FIGs. 1-2 & cols. 5-6.	1-2, 14-21, 33-38
A	WALLACE et al, Haskell and XML: Generic Combinators or Type-Based Translation?, ACM September 1999, pages 148-159. See entire document.	1-2, 14-21, 33-38

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 12 APRIL 2002	Date of mailing of the international search report 09 MAY 2002
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer For TUAN Q. DAM James R. Matthews Telephone No. (703) 305-3900

Form PCT/ISA/210 (second sheet) (July 1998)★

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

FILE COPY 220

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

Form PCT/ISA/220 (April 2002) DO NOT MAIL

Applicant's or agent's file reference 41016.P009	Date of Mailing *(day/month/year)*
International application No. PCT/US01/46928	**FOR FURTHER ACTION** **See paragraphs 1 and 4 below**
Applicant BEA SYSTEMS, INCORPORATED	International filing date *(day/month/year)* 09 NOVEMBER 2001

1. [X] The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90 *bis*.1 and 90*bis*.3, respectively, before the comletion of the technical preparations for international publication.

Within **19 months** from the priority date, but only in respect of some designated Offices a demand for international preliminary examination must be filed if trhe applicant wishes to postpone the entry inton the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other desginated Offices, the time limit of **30 months** (or later) will apply even in if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Facsimile No. (703) 305-3230	Authorized officer AND Telephone No. TUAN Q. DAM (703) 305-3900 TUAN Q. DAM PRIMARY EXAMINER

PATENT COOPERATION TREATY
FILE COPY 210

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Form PCT/ISA/210 (first sheet) (July 1998) **DO NOT MAIL**

Applicant's or agent's file reference 41016.P009	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US01/46928	International filing date *(day/month/year)* 09 NOVEMBER 2001	(Earliest) Priority Date *(day/month/year)* 10 NOVEMBER 2000
Applicant BEA SYSTEMS INCORPORATED		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of ____ sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has b een furnished.

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[ ] the text is approved as submitted by the applicant.

[X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

Form PCT/ISA/210 (second sheet) (July 1998)

FILE COPY - DO NOT MAIL

International application No.
PCT/US01/46928

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 9/45

US CL :717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 717/114-119, 136, 139-143, 146-149; 707/501.1, 513, 522-524

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST 1.3 (USPAT; EPO; JPO; DERWENT; IBM_TDB), IEEEXplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US 6,339,839 B1 (WANG) 15 January 2002, Abstract, FIGs. 1-3 & 6, col. 1:12-63, col. 6:33-61, cols. 7-8.	1-38
X,E P	US 6,292,936 B1 (WANG), Abstract, FIGs. 1-3 & 5, col. 1:12-52, col. 2:17-67, col. 6:16-67. 18 September 2001	1-38
A	US 6,066,181 A (DEMASTER) 23 May 2000, FIG. 1 & at col. 2:5-21.	1-38
X	US 5,630,137 A (CARNEY et al) 13 May 1997, FIGs. 1-2 & cols. 5-6.	1-2, 14-21, 33-38
A	WALLACE et al, Haskell and XML: Generic Combinators or Type-Based Translation?, ACM September 1999, pages 148-159. See entire document.	1-2, 14-21, 33-38

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 12 APRIL 2002	Date of mailing of the international search report
Facsimile No. (703) 305-3230	Authorized officer AND Telephone No. TUAN Q. DAM (703) 305-3900 TUAN Q. DAM PRIMARY EXAMINER

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

PCT

NOTIFICATION CONCERNING PAYMENT OF PRESCRIBED FEES

(PCT Rules 14, 15 and 16 and Administrative Instructions, Sections 304(a) and (b) and 323(b))

Date of mailing *(day/month/year)*	25 Jan 2002
Applicant's or agent's file reference: 41016.P009	**PAYMENT DUE** see item 3 for time limits

International application No.	International filing date/Date of receipt *(day/month/year)*	Priority date *(day/month/year)*
PCT/US01/46928	09 Nov 2001	10 Nov 2000

Applicant: BEA SYSTEMS. INCORPORATED

1. The applicant is hereby notified that this receiving Office has received:

☒ **the payment** of all the prescribed fees, and ☐ **an overpayment**, which will be refunded in due course.

☐ **no or insufficient payment** of the prescribed fees and the applicant is hereby **invited to pay the balance due**, as summarized under item 2, within the time limit(s) indicated under item 3.

2. **Fees and payment calculation:**

1880.00 (Total fees payable) − 1880.00 (Amount paid) = 0 (Balance)

☐ The details of the calculation are given in the Annex.

3. **Time limit(s) for payment and amount(s) payable (Rules 14.1, 15.4 and 16.1(f)):**

☐ within ONE MONTH from the date of receipt of the international application (**for the transmittal fee** (if any), **the search fee, the basic fee and the designation fee**). The amount payable for each fee is the amount applicable on the date of receipt of the international application.

☐ within ONE YEAR from the priority date (**only for the designation fee** and only if this time limit expires later than the above time limit).
— If the designation fee is paid within one month from the date of receipt of the international application, the amount payable is the amount applicable on that date of receipt.
— If the designation fee is paid within one year from the priority date but later than one month from the date of receipt of the international application, the amount payable is the amount applicable on the date of payment. The receiving Office should be consulted for the applicable amount.

☐ within 16 MONTHS from the priority date (only for the fee for priority document). The applicant's attention is drawn to the fact that the request made by the applicant under Rule 17.1(b) will be considered not to have been made unless the fee is paid within that time limit.

4. Additional observations *(if necessary)*:

☐ The search copy will not be transmitted to the International Searching Authority until the search fee is paid (therefore the start of the international search will be delayed) (Rule 23.1(a) and (b)).

Name and mailing address of the receiving Office	Authorized officer
Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US	Darlene Proctor
Facsimile No. 703-305-3230	Telephone No. 703-305-3689

Form PCT/RO/102 (January 1999; reprint January 2000)

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Date of mailing *(day/month/year)*	25 Jan 2002
Applicant's or agent's file reference: 41016.P009	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US01/46928	09 Nov 2001	10 Nov 2000

Applicant: BEA SYSTEMS, INCORPORATED

Title of the invention: A MULTI-LANGUAGE EXECUTION METHOD

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

[x] was transmitted to the International Bureau on 25 Jan 2002.

[ ] has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

[ ] because the necessary national security clearance has not yet been obtained.

[ ] because *(reason to be specified)*:

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION — Completed by: DP

[ ] Additional license for foreign transmittal not required. This subject matter is covered by a license already granted or the equivalent U.S. national application. Refer to that license for information concerning its scope.

[ ] License for foreign transmittal not required. 37 CFR 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).

[x] Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on 19 Jan 2002 (date):

[x] 37 CFR 5.15(a) [ ] 37 CFR 5.15(b)

Name and mailing address of the receiving Office	Authorized officer
Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US	Darlene Proctor
Facsimile No. 703-305-3230	Telephone No. 703-305-3689

Form PCT/RO/105 (July 1992)

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

PCT

INVITATION TO CORRECT DEFECTS IN THE INTERNATIONAL APPLICATION

(PCT Articles 3(4)(i) and 14(1) and Rule 26)

Date of mailing *(day/month/year)*	25 Jan 2002
Applicant's or agent's file reference: 41016.P009	**REPLY DUE** within 1 months / days from the above date of mailing
International application No.: PCT/US01/46928	International filing date *(day/month/year)*: 09 Nov 2001
Applicant: BEA SYSTEMS. INCORPORATED	

1. The applicant is hereby **invited**, within the time limit indicated above, to correct the defects **in the international application as filed**, the defects specified on the attached
   - [x] Annex A
   - [ ] Annex B1 *(text matter of the international application as filed)*
   - [ ] Annex C1 *(drawings of the international application as filed)*

2. The applicant is hereby **invited**, within the time limit indicated above, to correct the defects **in the translation of the international application** furnished under Rule 12.3, the defects specified on the attached
   - [ ] Annex A
   - [ ] Annex B2 *(text matter of the translation of the international application)*
   - [ ] Annex C2 *(drawings of the translation of the international application)*

Additional observations (if necessary):

HOW TO CORRECT THE DEFECTS?

Correction must be submitted by filing a replacement sheet embodying the correction and a letter accompanying the replacement sheet, which shall draw attention to the difference between the replaced sheet and the replacement sheet. A correction may be stated in a letter only if it is of such a nature that it can be transferred from the letter to the record copy without adversely affecting the clarity and direct reproducibility of the sheet onto which the correction is to be transferred (Rule 26.4(a)).

ATTENTION

Failure to correct the defects will result in the international application being considered withdrawn by this receiving Office (see Rule 26.5 for further details).

A copy of this invitation and any attachments has been sent to the International Bureau
- [x] and the International Searching Authority.

Name and mailing address of the receiving Office Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US Facsimile No. 703-305-3230	Authorized officer Darlene Proctor Telephone No. 703-305-3689

Form PCT/RO/106 (July 1998)

ANNEX A TO FORM PCT/RO/106

International application No.
PCT/US01/46928

The receiving Office has found the following defects in the international application as filed:

1. As to **signature*** of the international application (Rules 4.15 and 90.4), the request:
   a. ☐ is not signed.
   b. ☐ is not signed by all applicants.
   c. ☐ is not accompanied by the statement referred to in the check list in Box No. VIII of the request explaining the lack of the signature of an applicant for the designation of the United States of America.
   d. ☒ is signed by what appears to be an agent/common representative but
      ☐ the international application is not accompanied by a power of attorney appointing him.
      ☒ the power of attorney accompanying the international application was not signed by all the applicants.
   e. ☐ other (*specify*):

* All applicants must sign, including inventors if they are also applicants (e.g. where the United States of America is designated).

2. As to indications concerning the **applicant**, the request (Rules 4.4 and 4.5):
   a. ☐ does not properly indicate the applicant's name (*specify*):
   b. ☐ does not indicate the applicant's address.
   c. ☐ does not properly indicate the applicant's address (*specify*):
   d. ☐ does not indicate the applicant's nationality.
   e. ☐ does not indicate the applicant's residence.
   f. ☐ other (*specify*):

3. As to the **language** of certain elements of the international application, other than the description and claims (Rules 12.1(c) and 26.3*ter(a) and (c)*):
   a. ☐ the **request** is not in a language which is both a language accepted by this receiving Office and a language of publication, which is (are):
   b. ☐ the **text matter of the drawings** is not in the language in which the international application is to be published, which is:
   c. ☐ the **abstract** is not in the language in which the international application is to be published, which is:

4. The **title** of the invention:
   a. ☐ is not indicated in Box No. I of the request (Rule 4.1(a)).
   b. ☐ is not indicated at the top of the first sheet of the description (Rule 5.1(a)).
   c. ☐ as appearing in Box No. I of the request is not identical with the title heading the description (Rule 5.1(a)).

5. As to the **abstract** (Rule 8):
   ☐ the international application does not contain an abstract.

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD. SUITE 820
PORTLAND, OREGON 97223

PCT

NOTIFICATION REGARDING CERTAIN CORRECTIONS MADE *EX OFFICIO*

(PCT Administrative Instructions, Section 327)

Date of mailing *(day/month/year)*	25 Jan 2002
Applicant's or agent's file reference: 41016.P009	**REPLY DUE** NONE However, see paragraph 3 below
International application No.: PCT/US01/46928	International filing date *(day/month/year)*: 09 Nov 2001
Applicant: BEA SYSTEMS. INCORPORATED	

1. The applicant is hereby notified that this receiving Office has corrected formal defects in the international application *ex officio*, as shown on the attached copy of:

- [x] the request, sheet No.: 1 AND 2
- [ ] the description, sheet No.: _____
- [ ] the claims, sheet No.: _____
- [ ] the drawings, sheet No.: _____
- [ ] other *(specify)*: _____

2. If the applicant agrees with these corrections, no further action is required in this regard.

3. **In case of disagreement** with these corrections, the applicant should promply inform this receiving Office accordingly.

Name and mailing address of the receiving Office Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US Facsimile No. 703-305-3230	Authorized officer Darlene Proctor Telephone No. 703-305-3689

Form PCT/RO/146 (July 1992)

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
ALOYSIUS T. C. AUYEUNG
COLUMBIA IP LAW GROUP, PC
10260 SW GREENBURG ROAD, SUITE 820
PORTLAND, OREGON 97223

PCT

NOTIFICATION OF RECEIPT OF SEARCH COPY

(PCT Rule 25.1)

Date of mailing *(day/month/year)*	25 Jan 2002
Applicant's or agent's file reference: 41016.P009	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US01/46928	09 Nov 2001	10 Nov 2000

Applicant: BEA SYSTEMS. INCORPORATED

1. **Where the International Searching Authority and the receiving Office are not the same Office:**
The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

Where the International Searching Authority and the receiving Office are the same Office:
The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

25 Jan 2002 *(date of receipt).*

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing in computer readable form.

3. **Time limit for establishment of international search report**
The applicant is informed that the time limit for establishing the international search report is 3 months from the date of receipt indicated above or 9 months from the priority date, whichever time limit expires later.

4. A copy of this notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the receiving Office.

Name and mailing address of the ISA/	Authorized officer
Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US	Darlene Proctor dp
Facsimile No. 703-305-3230	Telephone No. 703-305-3689

Form PCT/ISA/ 202(July 1998)

TO:	UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)
ALOYSIUS T. C. AUYEUNG COLUMBIA IP LAW GROUP, PC 10260 SW GREENBURG ROAD, SUITE 820 PORTLAND, OREGON 97223	**NOTIFICATION OF STATUS OF REQUIREMENTS UNDER 35 U.S.C. 371**
	DATE OF MAILING *(day/month/year)* 25 Jan 2002
	FILE REFERENCE 41016.P009

IDENTIFICATION OF INTERNATIONAL APPLICATION

International application No.	International filing date *(day/month/year)*	Priority Date Claimed
PCT/US01/46928	09 Nov 2001	10 Nov 2000

Applicant for DO/EO/US

BAU, DAVID

NOTIFICATION

The applicant is hereby advised that the U.S. Patent and Trademark Office in its capacity as [x] Designated Office [ ] Elected Office has received following items as of the date of mailing indicated above.

1. [ ] U.S. Nation fee [35 U.S.C 371 (c) (1)]
2. [ ] Oath of declaration [35 U.S.C 371 (c) (4)]
3. [x] Copy of International application as [35 U.S.C 371 (c) (2)]
4. [ ] Translation of Application [35 U.S.C 371 (c) (2)]
5. [ ] Amendments under PCT Article 19 [35 U.S.C 371 (c) (3)]
6. [ ] Translation of PCT Article 19 Amendments [35 U.S.C 371 (c) (3)]
7. [ ] Search Report or Declaration under PCT Article 17(2) [35 U.S.C 371 (a)]
8. [ ] International Preliminary Examination Report and its Annexes, if any, under PCT Article 36(3)(b) [35 U.S.C 371 (a)]
9. [ ] Translation of Annexs to the International Preliminary Examination Report under PCT Article 36(3)(b) [35 U.S.C 371 (c) (5)]
10. [ ] Other items received:
    - [ ] Assignment Document
    - [ ] Prior Art Statement
    - [ ] Preliminary Amendment

A. [ ] Requirements for U.S. National processing have been met. Processing will commence
- [ ] at the expiration of the applicable time limit under either
  - [ ] PCT Article 22 [35 U.S.C 371 (b)] or
  - [ ] PCT Article 39 [35 U.S.C 371 (b)]
- [ ] on the date indicated below under the provisions of 35 U.S.C 371 (f)

U.S. NATIONAL SERIAL#	DATE UNDER 35 U.S.C. 102(e)	DATE OF COMMENCEMENT OF NATIONAL PROCESSING

All correspondence submitted after the date of commencement of U.S. National processing indicated above should refer to the U.S. National Serial Number and the appropriate U.S. National processing organization of Officer.

B. [ ] As the above identified application has been accepted for U.S. National processing under the provision of 35 U.S.C.371 (f) before expiration of the applicable time limit under [ ] PCT Article 22 [ ] PCT Article 39, applicant is reminded that
- [ ] Amendments under PCT Article 19 and/or
- [ ] the International Preliminary Examination Report and its Annexes, if any, under PCT Article 36(3) (a), and (b) and any translation thereof, if applicable, must be submitted to the Patent and Trademark Office as soon as they are available.

International application No.	International filing date	Priority Date Claimed
PCT/US01/46928	09 Nov 2001	10 Nov 2000

C. [x] In order that U.S. National processing may begin, certain items must be received by the DO/EO/US by the expiration of applicable time limit under

- [x] PCT Article 22 or
- [x] PCT Article 39.

Specifically:

- [x] 1. U.S. National Fee
- [x] 2. Oath or Declaration
- [ ] 3. Copy of Application
- [ ] 4. Translation of application
- [x] 5. Amendments under PCT Article 19, if any
- [ ] 6. Translation of PCT Article 19 Amendments, if applicable
- [ ] 7. Search Report or PCT Article 17(2) declaration
- [ ] 8. International Preliminary Examination Report and its Annexes, if any, under PCT Article 36(3)(a), if applicable
- [ ] 9. Translation of Annexs to the International Preliminary Examination Report under PCT Article 36(3)(b), if appliable

THE ABOVE CHECK ITEMS MUST BE TIMELY RECEIVED TO AVOID ABANDONMENT OF THE APPLICATION. [35. U.S.C. 371(d)]

D. Further information for the applicant:

This is only a reminder.

UNITED STATES DESIGNATED/ELECTED OFFICE

Address Only:	Authorized Officer
Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US	Darlene Proctor dP 703-305-3689

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Date	09 November 2001
International Application No.	Not yet assigned
Attorney Docket No.	41016.P009

PCT/US 01/46928

I. Certification under 37 CFR 1.10 (if applicable)

EV051081811US	09 November 2001
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D.C. 20231.

Signature of person mailing correspondence	Aloysius T.C. AuYeung
	Typed or printed name of person mailing correspondence

II. ☑ New International Application

TITLE: A MULTI-LANGUAGE EXECUTION METHOD	Earliest priority date (Day/Month/Year): 10 November 2000

SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign tranmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was **not** made in the United States.

B. ☐ There is no prior U.S. application relating to this invention.

C. ☑ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (*NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority.)*

application no.	60/246,915	filed on	10 November 2000
application no.	60/246,916	filed on	10 November 2000

D. ☐ The present international application contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages _____ and ☐ **DOES NOT ALTER** ☐ **MIGHT BE CONSIDERED TO ALTER** the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1. See 37 CFR 5.15

III. ☐ A Response to an Invitation from the RO/US. The following document(s) is(are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims			

D. ☐ Submission of Priority Documents

Priority document		Priority document	

E. ☐ Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. ☐ A Request for Rectification under PCT 91 ☐ A Petition ☐ A Sequence Listing Diskette

V. ☑ Other (please specify):

Copy of General Power of Attorney (1 page); Return receipt postcard

The person signing this form is the:

☐ Applicant	Aloysius T.C. AuYeung
☑ Attorney/Agent (Reg. No.)	Typed name of signer
☐ Common Representative	Signature

PCT/US01/46928

UNITED STATES RECEIVING OFFICE(RO/US) FEE CODING AND RECORDING SHEET ☐ Add'n Sheets

IDENTIFICATION OF THE INTERNATIONAL APPLICATION

International application No | International filing date (day/month/year)

Applicant (Name)

PAYMENTS				REFUNDS	
Payment on Filing	Deposit Account	Deposit Account		To Deposit Account	To Deposit Account
Deposit Account	Date:	Date:		Date:	Date:
☐ CASH/CHECK	☐ CASH/CHECK	☐ CASH/CHECK		☐ BY CHECK	☐ BY CHECK
150	566 30				
151					
153					
800					
801					
802					
899					
906					
159 Total Paid:	Total Paid: 30.00	Total Paid: 0.00		Total Refunded: 0.00	Total Refunded: 0.00
States included for 892:	892:	892:			
States included for 893:	893:	893:			

CALCULATED FEE AMOUNT =

AMOUNT OF DIFFERENCE =

12/18/200 LLANDGRA 00000092 PCT/US01/46928

01 FC:150 240.00 OP
02 FC:151 700.00 OP
03 FC:800 382.00 OP
04 FC:801 36.00 OP
05 FC:899 492.00 OP

RO/US Authorization	RO/US Authorization	RO/US Authorization	RO/US Authorization	RO/US Authorization

Form PCT/RO/102 (U S VERSION) (Rev. 07-97) U S DEPARTMENT OF COMMERCE - Patent and Trademark Office

01/22/2002 PVULPE 00000004 501569 PCT/US01/46928

01 FC:566 30.00 CH